Australian Government
Department of Defence
Defence Science and
Technology Organisation

The Army Learning Organisation Questionnaire: Developing a valid and reliable measure of Learning Organisation characteristics

Christina Stothard

Land Division
Defence Science and Technology Organisation

DSTO-TN-1325

ABSTRACT

This report describes the development and psychometric evaluation of the Army Learning Organisation Questionnaire (ALOQ). Following a review of social sciences literature, four questionnaires used to measure learning organisation characteristics were identified, and then evaluated against specific validity and reliability criteria. Two instruments had the best psychometric properties: Marsick and Watkins' (2003) Dimensions of a Learning Organization (DLOQ) and Goh and Richard's (1997) Organisation Learning Survey (OLS). These two questionnaires were adapted for use within the Army using a three phase pilot process. The resulting questionnaire was named the ALOQ. The ALOQ was administered to the target population (390 Army personnel) and its psychometric properties were evaluated. The ALOQ statistical reliability was found to be acceptable; Cronbach alphas were found to be over 0.7 for dimensions. ALOQ validity was evaluated using both theoretical and statistical means. An exploratory factor analysis (N=3700 Army personnel) found latent factors in line with those found in DLOQ and OLS. Hence the ALOQ was found to be a reliable and valid measure of learning organisation characteristics, suitable for administration within the military.

Published by

Land Division
DSTO Defence Science and Technology Organisation
506 Lorimer St
Fishermans Bend, Victoria 3207 Australia

Telephone: 1300 333 362
Fax: (03) 9626 7999

AR-016-028
July 2014

APPROVED FOR PUBLIC RELEASE

The Army Learning Organisation Questionnaire: Developing valid and reliable measure of Learning Organisation characteristics

Executive Summary

This report discusses the development of the Army Learning Organisation Questionnaire (ALOQ). Learning at the individual, team, and organisational levels determines an organisation's capacity to generate, share and exploit useful information. Learning within and by organisations is not merely a 'nice to have' - it is critical to improving organisational performance. Individual, team (or collective) and organisational level learning have all been linked to improved organisational performance.

Yet the ability (and capacity) to learn (at individual, team and organisation levels) is not equally visible to decision-makers. Developing and sustaining the learning capacity across an organisation requires decision-makers to be informed about these capabilities. The Army has stated its aspiration to be "a Learning Organisation"; consequently the ALOQ was developed in order to provide this information to key Army decision-makers. The ALOQ aimed to be a valid and reliable measure providing valuable and practical data on Army's strengths and weaknesses in this area. Thus, the ALOQ was designed to provide critical data to senior Army personnel to inform their decision-making.

The study sought to answer the following questions:

- What is the reliability and validity of currently existing instruments for measuring Learning Organisation characteristics?
- Can these instruments be usefully and meaningfully applied to the Australian Army context?

Creating quantitative measures of social phenomena requires developing meaningful, concrete measures from the conceptual and theoretical construct (for example, a Learning Organisation would include information sharing, open questioning etc.). These concrete measures should be specific and unambiguous, with logical links to the theoretical construct. When developing psychometric measurements, the measures should be evaluated for reliability and validity. A reliable measure is consistent over time, across populations and situations. Validity is the extent to which the measure measures the intended phenomena, for example, to what extent can inferences can be drawn from the results of the measure. Reliability is a necessary but not sufficient condition to ensure validity. Reliability and validity can be assessed using both theoretical and statistical analysis.

A systematic literature review for measures of Learning Organisations was conducted, finding four instruments. These instruments were evaluated against well–established criteria of reliability and validity. Of the four instruments, only Marsick and Watkins' (2003) Dimensions of Learning Organisation Questionnaire (DLOQ) and Goh and Richard's Organisation Learning Survey (OLS) had published acceptable levels of reliability and validity[1], and hence, were selected to be the basis for the ALOQ. The other two instruments were not found to have published levels of reliability and validity, or did not provide permission for their use outside the author's own website.

The DLOQ and OLS were adapted to the Army in order to develop an instrument, which was termed the ALOQ. Development included an iterative pre-test phase with Army personnel. The subsequent statistical analysis (N=390 Army personnel) found that the ALOQ had acceptable level of reliability with all dimensions being above the acceptable level of Cronbach's alpha 0.7. An exploratory factor analysis (EFA) was conducted to evaluate the statistical validity (N=3700 Army personnel); the results of the EFA showed that similar factors emerged from the ALOQ items compared to with the DLOQ and OLS. There was one small difference between the ALOQ latent factors and those found in the DLOQ; the ALOQ EFA found eight factors, compared to the seven found by Marsick and Watkins' DLOQ. The DLOQ original factor *continuous learning opportunities* was found to load onto two separate ALOQ factors; *rewards and resources* and *learning practices*. This means that, for the Army, the organisational-level aspects of learning (resourcing) were not directly influencing the actions and practices that support learning within a workplace or unit. The EFA found that Goh and Richard's (1997) four OLS factors were replicated within the ALOQ data. This means that there was a similar underlying factor influencing the Army's ALOQ results as found within Goh and Richard's (1997) sample. These results support the theoretical model of learning organisations developed by Marsick and Watkins' (2003) and Goh and Richard's (1997).

In summary, the ALOQ was found to have satisfactory statistical levels of reliability within its target population. The EFA of the ALOQ show alignment with the original work of Marsick and Watkins' (2003) and Goh and Richard's (1997) supporting their theoretical models of learning organisations. Consequently, the ALOQ is assessed as valid and reliable means of measuring the learning organisational characteristics practiced within the Army.

[1] Acceptable level of reliability set as achieving 0.70 Cronbach alpha as a minimum (Nunnally, 1978; Pallant, 2007; Steiner & Norman, 2003). Validity is assessed using nomological network and its relationship to item construction using theoretical constructs and relationships (Babbie 1995; Clark and Watson, 1995; Streiner and Norman, 2003).

Contents

Acronyms

ALE	Army Learning Environment
ALO	Army Learning Organisation
ALOQ	Army Learning Organisation Questionnaire
CPL	Corporal
DF	Degrees of Freedom
DLOQ	Dimensions of a Learning Organization Questionnaire
EFA	Exploratory Factor Analysis
FIML	Full Information Maximum Likelihood
KMO	Kaiser-Meyer-Oklin
LEQ	Learning Environment Questionnaire
LO	Learning Organisation
LOS	Learning Organization Survey
LWDC	Land Warfare Development Centre
LTCOL	Lieutenant Colonel
ML	Maximum Likelihood Extraction Method
NCO	Non-commissioned Officers
OLS	Organisational Learning Survey
OR	Other Ranks
PC	Principle Component Extraction Method
SPSS	Statistical Package for the Social Sciences
WO1	Warrant Officer 1
WO2	Warrant Officer 2

This page is intentionally blank

1. Introduction

This report describes the development and psychometric evaluation of the Army Learning Organisation Questionnaire (ALOQ). The ALOQ has been designed to measure organisational characteristics that are known to support learning within, and by, organisations. Learning at the individual, team, and organisational levels all contribute to an organisation's capacity to generate, share and exploit information. Yet the capacity to learn is not necessarily readily (or equally) visible. The Army has stated its aspiration to be "a Learning Organisation" (Australian Army, 2007). Developing a valid and reliable instrument to measure the Army's learning capabilities allows us to capture valuable and practical data that can then be used by senior Army decision-maker and stakeholders to inform their decision-making. Understanding Army's current capability to learn is a vital step; using this knowledge, decision-makers can then decide how to best apply and exploit their limited resources (including effort, and attention) to maximise learning. Developing a measure of the Army's learning capability presents critical information for improving organisational performance and evaluating the impact of proposed organisational initiatives.

Initially, this report describes the application of social sciences principles. The report then briefly reviews the literature on organisational learning. The available organisational learning survey instruments were critiqued against the two most important psychometric criteria; validity and reliability. The best of the available instruments were adapted to apply to the Army, producing the ALOQ; the adaptations and modifications of these questionnaires are described. The final part of the report evaluates the ALOQ using psychometric criteria of validity and reliability and it also discusses the utility of the ALOQ to the Army.

2. Background

2.1 Psychometric Measures

Babbie contends that the social sciences measure "the stuff of life; love, hate, prejudice, radicalism, [and] alienation" (1995, p. 110). Social science offers a way of measuring "the stuff of life" by observing and quantifying hypothesised concepts by applying the following process (see Figure 1).

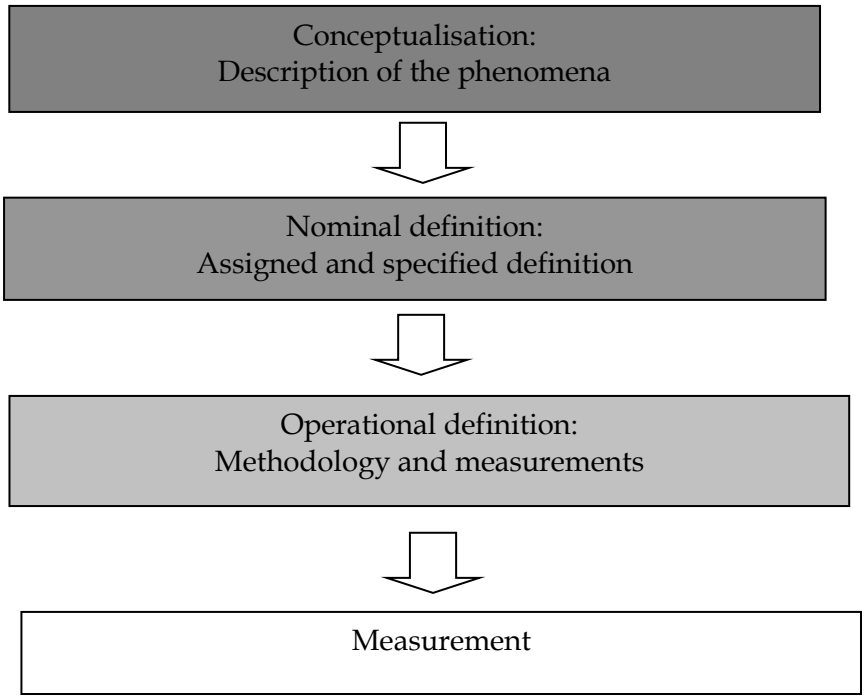

Figure 1: From Conceptualisation to Measurement: Quantifying theoretical constructs (Babbie, 1995).

The aim of this process is to make a workable definition of the phenomena of interest, so that it is specific and unambiguous; whilst somebody may disagree with the definition, they can trace how the measures are achieved (Babbie, 1995). There is frequently a tension between the precision necessary for scientific inquiry and the contextual information that is embedded within social phenomena. In this respect, often the specification needed for operational definitions seem to rob concepts of their richness and meaning. If there is no single clear way to measure a concept, the use of multiple methods (including triangulation) can be employed to build up a richer picture of the concept. Using multiple methods also addresses the issues associated with measurement errors (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

Stevens' definition (1946: p.677) of measurement as "the assignment of numerals to objects or events according to some rule" is the accepted definition of measurement in social sciences. Measurement can be classed into four different types: "nominal" scale (or categorical), "ordinal" scale, "interval" scale and "ratio" measurement. The type of measurements or data collected determines the levels of analysis that can be conducted. For example, gender is measured as a nominal scale and hence, can only be analysed using non-parametric methods of analysis or used as a means of grouping the sample (e.g. comparing males to females).

The use of the word "assignment" within the concept indicates that measurement or quantification is arbitrary or subjective. Developing scales to measure subjective attributes

is neither easy nor simple and requires "considerable investment of both mental and fiscal resources" (Streiner & Norman 2008; p5). Developing and using a response scale which assigns both a useful and meaningful value requires a systematic approach. Psychological and educational researchers have developed a comprehensive set of standards used to assess such measures (Streiner & Norman, 2008). The standards were set out in a manual (*Standards for Educational and Psychological Testing*) and published jointly by the American Educational Research Association, the American Psychological Association and the National Council on Measurement in Education (AERA/APA/NCME, 1999).

2.1.1 Key Concepts in Psychometrics: Reliability and validity

Psychometrics' key concepts include reliability and validity (Campbell, 1960; Carmines & Zeller, 1979; Streiner & Norman, 2003; 2008). A reliable measure is one that measures the consistency of a construct (over time, across individuals and situations). Validation is the extent that you can draw inferences from the test (Streiner & Norman, 2003; 2008), or the degree to which the measurement process measures the construct it claims to measure (Gravetter &Forzano, 2009). Reliability is a necessary but not sufficient condition to ensure validity. Both reliability and validity can, and are, assessed statistically (Streiner &Norman 2003, 2008; Holmes-Smith, 2011).

2.1.2 Reliability

Reliability is "a fundamental way to reflect the amount of error, random and systematic, inherent in any measurement" (Streiner & Norman, 2003; p 126). Streiner and Norman (2003) describe how reliability has been formally based on classical test theory and simply state that any observation is made up of two components: a true score, and an error associated with the measurement. The reliability formula, called *intraclass correlation*, was first described by Fischer (1925) to examine the extent of inter-rater agreement. A number of formulations of inter-rater reliability have been developed including test-retest correlations (Pearson correlation coefficient) to compare rater's results over time and across populations or situations (Streiner & Norman, 2003, 2008).

A self-completed measure has a different source of error when compared to rater-completed measures; self-completed measures have internal consistency of a measure as a source of error. Internal consistency (the homogeneity of a single test) may be assessed using several difference approaches; item-total correlation, split-half reliability and Cronbach's alpha. The item-total correlation is "the correlation of the individual item with the scale total *omitting the item*" (Streiner & Norman, 2003, p 70 italics as original). The guide for establishing a useful correlation between the item and the total score is above 0.20; items with lower correlations should be discarded (Kline, 1986). Streiner and Norman (2003) state that the most common correlation coefficient is the Pearson correlation coefficient, as it is sufficiently robust to withstand a non-normal distribution. The split-half reliability is calculated by randomly dividing into two sub-scales, which are then correlated with each other. If the scale is consistent, the two subscales should be highly correlated.

The most commonly used index of reliability is Cronbach's alpha (Cronbach, 1951; De Vellis, 2003; Nunnally, 1978; Pallant, 2007; Streiner & Norman, 2003, 2008). Cronbach's alpha builds on the utility of the split-half reliability, and also allows for an examination of each item's contribution to the overall reliability of the scale. Cronbach's alpha give the average of all the possible split-halves reliabilities of the scale. The scale's alpha is calculated, omitting each item in turn. If the alpha increases when a specific item is removed, this indicates that the homogeneity or internal consistency of the scale is improved. Streiner and Norman (2003) point out that alpha is dependent upon both the number of items within the scale and the magnitude of the correlations between the items. A very high alpha may in fact be generated from item redundancy, hence, the alpha should be above 0.70 but normally not higher that 0.90 (Streiner, 2003a).

Reliability is not merely concerned with 'agreement' in a scale; the reliability of a scale is "intimately linked to the population to which one wants to apply the measure" (Streiner and Normal, 2003; p 130). Reliability coefficients only have meaning when applied to a specific population (Streiner, 2003a); so reliability is relative. The homogeneity of a population will determine the internal consistency of the measure, for example, Streiner and Norman (2003) give an example of how the variation within a quality of life scale would be very different if given to a homogenous group of rheumatoid patients compared to a group consisting of both disease-free or ankylosing spondylitis patients. The reliability of the scale will be greater in the homogenous group than the heterogeneous groups (Streiner, 2003a). Therefore, reliability coefficients need to be calculated anew each time the measure is used with a different population.

2.1.3 Validity

Validity is defined as the extent to which evidence and theory support the interpretations of the test score (AERA/APA/NCME, 1999); that is, the degree of confidence placed on the measure and therefore, the higher the validity of a measure, the greater the inferences that can be drawn under a variety of conditions (Streiner & Norman, 2003, 2008). Streiner and Norman (2003) define validity as "a process of *hypothesis testing´* (p 174, italics as original) such that validation allows inferences on the results to be drawn from the measures of a particular population or circumstance.

Validity can be assessed in a variety of ways (Weiner & Braun, 1988; Cronbach & Meehl, 1955; Babbie, 1995; Cook &Beckman, 2006; Streiner & Norman, 2003) and historically, four types have been defined:

- Construct validity: the extent to which the practical test actually measures the phenomena, for example, to what extent do IQ questionnaires measure real world intelligence?
- Content validity: the extent to which the measure covers the phenomena investigated, for example, does an IQ questionnaire measure *all* aspects of intelligence discussed within the scientific literature?

- Criterion validity: the degree of correlation between the measure and an established measure or test (the criteria) already shown to be valid, for example, IQ tests are often correlated with measures of academic performance (the criterion).
- Predictive validity: the extent the measure correctly forecasts other results of the same construct in the future. For example, does an IQ test correctly predict the person's future academic performance?
- Face validity: to what extent does a test appear to measure the behaviour of interest. For sensitive issues, face validity may generate biases, for example, faking good or faking bad to make the respondents appear in a more socially desirable light.

These different aspects of validity are, in fact, nested. Content validity encompasses all of the above dimensions of validity (Streiner & Norman, 2003, 2006). The extent to which a measures predicts outcome (predictive validity) or is correlated to a related outcome (criterion validity) rest upon the inclusion of all aspects of the phenomena (construct validity), which determines the extent to which the measure can be used to infer consequences (content validity). Current thinking in the area focuses on all aspects of content validity as a holistic approach (Streiner & Norman, 2003; 2006).

2.1.3.1 Content Validity

Content validity is the degree to which a measure encompasses the relevant or important aspects, given the theoretical grounding of the construct of interest (Babbie, 1995; Streiner & Norman, 2003, 2008). Once the items have been developed by applying Babbie's process from conceptual definition to an operational definition and then concrete measures, content validity refers to how much of the concrete measures cover the desired aspects of the original conceptual definition. Assessing content validity can be done by assessing the extent to which the operationally defined measures match all aspects of the conceptual definition. Are there any pertinent factors that have not been covered within the operational definition, and are there any irrelevant aspects included within the operational definition that do not contribute to the conceptual definition? This comparison needs to be done, initially, at a theoretical level as it requires a thorough understanding of the conceptual and theoretical basis of the phenomenon of interest.

Validity can be evaluated statistically, as well as theoretically. Applying an exploratory factor analysis (EFA) to a data set about the phenomena of interest is a means of analysing the underlying structure of the data; EFA is a means of establishing if the empirical evidence aligns with the theorised models. If the theory is correct, then the factors emerging from the EFA should align with the theorised model.

2.1.4 Summary

In order to assess the utility of any questionnaire (or instrument, measure, scale) the key criteria are that it be reliable and valid. Reliability means that the instrument is measuring *something* in a reproducible fashion; it is commonly defined as the ratio of the variability between the individuals to the total variability in the scores. In self-report measures, internal consistency and stability are key aspects of reliability. These can be assessed

empirically using various statistical analyses (Cronbach's alpha and correlation, respectively). Validity is the extent to which a test measures the real-world phenomena and needs to be assessed both theoretically and empirically. Although there are many approaches, they can be grouped into either:

- Comparisons of the measure to other similar scales/measures (and establishing the level of agreement between the newly developed and the established). The level of agreement would be statistically calculated most commonly using correlations, analysis of variance.
- Assessment of the extent to which the newly developed scale supports theoretically-expected relationships between known groups or differences.

Validity and reliability are key criteria in evaluating psychometrically measures; a valid and reliable measure provides useful and robust information that would otherwise be unavailable.

2.2 The Learning Organisation

To be successful in a competitive environment, organisations need to foster a culture for creating, acquiring, and transferring knowledge, and more significantly, modifying behaviour (at all levels) to reflect new knowledge and insights (Goh, Elliot & Quon, 2012; Edmondson, 2004; Edmondson, Bohmar & Pisano, 2001; Yang, Marsick & Watkins, 2004). Learning is not merely a 'nice to have'; successful learning is linked to improved organisational performance (summarised in Talbot, Stothard, Drobnjak and McDowall, in preparation). The ability to generate, capture, share and act on new knowledge and insights are hallmarks of a learning organisation (Garvin, 2008). Indeed, the term 'learning organisation' has become a common phrase for describing a host of approaches to organisational development and a plethora of definitions of a learning organisation exist (Talbot, Drobnjak, Stothard and McDowall, in prep; Senge, 1990). A variety of mechanisms or 'building blocks' are prescribed for ensuring the generation of cultural conditions that facilitate learning within an organisational context. Some of these building blocks include providing "strategic leadership for learning", "creating continuous learning opportunities", "promoting dialogue and inquiry", and "generating a shared vision" (Marsick & Watkins, 2003; Yang, Watkins &Marsick, 2004; Goh & Richards, 1997).

While the learning organisation construct has been used within a variety of organisations, very little attention has been given to the application of learning organisation practices within military institutions. The Australian Army faces a variety of unique organisational learning challenges (Talbot, Stothard, Drobnjak &McDowall, in prep; Talbot, Fidock, Drobnjak &Stothard, 2007; Talbot, 2006; Talbot &O'Toole, 2008; Stothard &Drobnjak, 2009a; 2009b). Newton (2010) found that Australian Army personnel's experiences of learning organisation characteristics were mainly determined by the organisational context. Participants reported greater levels of micro-management, risk averseness and had little ability to engage with responsive or creative work when in barracks.

A summary of the defining features of learning organisations is presented in Talbot, Stothard, Drobnjak, and McDowall (in prep). There are often multiple learning theories

employed within each definition (i.e. whether the definition draws on behavioural, cognitive, cultural, structural or systemic perspectives etc.), and whether the definition refers to the Learning Organisation as an aspirational quality or type of organisation.

2.2.1 Measuring the Learning Organisation

Despite the large number of papers describing or discussing the desirable characteristics of a Learning Organisation, relatively few attempts have been made at measuring these characteristics. Yet an understanding of the current situation, that is, a baseline of an organisation's current learning capabilities, is an essential step in developing organisational change in order to support and sustain learning. Consequently, the existing literature on measures of Learning Organisations was reviewed and four published instruments were found (Table 1).

Table 1: Currently available Measures of Learning Organisation capabilities

Instrument	Authors/Source	Availability/ Administration	Number of dimensions, response scale	Dimensions
Dimensions of Learning Organization Questionnaire (DLOQ)	Marsick & Watkins (2003)	Publically available	7 dimensions, 6 point scale	• Continuous learning practices • Dialogue and inquiry • Teamwork and collaboration • System – capture and share learning • Collective vision • Connect org. to environment • Strategic leadership for learning
Organizational Learning Survey (OLS)	Goh & Richards (1997)	Publically available	5 dimensions, 7 point scale.	• Clarity of mission, • Teamwork • Experimentation, • Leadership • Transfer of knowledge
Learning Environment Questionnaire (LEQ)	Armstrong & Foley (2003)	Publically available	2 factors in 4 issues	• Mission linked learning, • Facilitative learning environment, • Mission support • Learning identification satisfaction • Organisation support, Low personal impact, mentoring and coaching.
Learning Organization Survey (LOS)	Garvin, Edmondson & Gino (2008)	Online only through los.hbs.edu – not publically available	3 Building Blocks (dimensions) each made up of between 1 to 5 scales with 5 items each. Scoring is on 7 point scale	• Supportive learning environment • Concrete learning processes and practice, • Leadership that reinforces learning.

2.2.2 Research Questions

The four questionnaires are critiqued and reviewed in order to provide the basis for developing a measure of the Army's organisational learning capabilities. The development of a valid and reliable instrument to measure the Army's learning capabilities supports the generation of useful information that can then be used to inform Army decision makers. To achieve this, the following questions were investigated:

- What is the reliability and validity of existing instruments that measure Learning Organisation characteristics?
- Can these instruments be applied to the Army?

3. Method

Developing measures of subjective experiences, especially at the organisational level (e.g. a learning culture) requires considerable investment. Streiner & Norman (2003, 2008) extensively reviewed the methods for developing measures of subjective attributes or experiences. They describe the ideal development process of scale development. This process has been applied to the development of the ALOQ; the theoretical validity of the ALOQ was examined using the nomological process described by Babbie (1995) and Streiner and Norman (2003; 2008).Streiner and Norman (2003) describe the following process as:

1. Find any existing scales or measures within the literature
2. Critically review measures
    a. Reliability
    b. Validity
3. Pre-test measures on a target population to ensure that items or questions are
    a. Comprehensible
    b. Unambiguous
    c. Only ask a single question
4. Eliminate or rewrite items in response to the pre-test, and repeat until the items fulfil the criteria of being understandable, clear and only ask a single question.
5. Check for internal consistency of the developed measures for the target population:
    a. Reliability criteria
    b. Validity criteria.
6. Conduct statistical analysis using target population in order to evaluate the measures' empirical validity using Cronbach alpha and exploratory factor analysis (EFA).

The statistical reliability of the DLOQ and OLS dimensions were analysed, using the software package *IBM SPSS* (Statistics Package for the Social Sciences).

3.1 Evaluation of Learning Organisation Measures

A review of the open literature yielded four instruments (Table 1). Despite the large number of papers describing Learning Organisations (LO) only a few attempts have been made at measuring their characteristics. All four papers of the instrument development shared the main themes found within the LO literature (such as the importance of communication, leadership, teamwork, information processes and infrastructure, and shared engagement in generating learning capacity within organisations). The next step was to examine the reliability and validity of these instruments.

3.2 Validity of Learning Organisation Measures

Given that Streiner and Norman (2003, 2008) describe how validity should be first assessed on a theoretical basis, the instruments were reviewed using Babbie's (1995) approach; a process of explicitly moving from the conceptual definition towards the operational definition as a framework. Babbie (1995) posits that the foundation of valid measures is based in the theoretical model within which it is framed. Thus, all measures of a subjective experience need to explicitly link the hypothesised underpinning constructs.

3.2.1 Conceptualisation

There are a number of formal definitions within the published literature on what constitutes a learning organisation (see Talbot et al in prep). The definitions draw on behavioural, cognitive, cultural, structural and systemic perceptions. All of the instruments reviewed were underpinned by specific (but differing) definitions of a learning organisation. For example Marsick and Watkins (2003; p. 8) emphasised the behavioural and adaptive aspects of their definition: a learning organisation "learns continuously and transforms itself". In a similar fashion, Garvin (1993; p. 80) focuses on the cognitive, behavioural and adaptive aspects when defining a learning organisation. Goh and Richards (1997; p. 577) use a normative perspective, describing learning as a collective activity that takes place under particular organisational conditions. Interestingly, Goh and Richards adopt Garvin's (1993) definition of a learning organisation; "A learning organisation is an organisation skilled at creating, acquiring and transferring knowledge and at modifying its behaviour to reflect new knowledge" when they developed the Organizational Learning Survey (OLS).

3.2.2 Nominal Definition

The authors of all four instruments developed a nominal or working definition for a learning organisation, which in turn, underpinned the operational definition (Marsick & Watkins, 2003; Garvin & Edmondson, 2008; Goh & Richards, 1997, Armstrong &Foley, 2003). All authors defined learning organisations as a complex, multilayered construct,

and therefore, have used multiple dimensions in their operational definitions as Babbie (1995) recommended. The nominal definition essentially described learning organisations to be made up of different dimensions (all generated from a theoretical and empirical basis), and the common aspects include (Talbot, Drobnjak, Stothard &McDowall, in preparation):

- learning occurring within organisational levels or subsystems
- organisational culture e.g. norms, attitudes, accepted practices
- systems thinking
- teamwork
- communication
- leadership
- information infrastructure
- engagement with shared understanding or vision.

Thus, the nominal definition of a learning organisation is one which exhibits specific aspects or characteristics, for example, personnel can have robust discussion within a team, find specific lessons learnt within the organisation, or question a team leader safely (Watkins &Marsick, 2003; Garvin, Edmondson, &Gino, 2008). Using multiple dimensions within a nominal definition for a complex construct allows for a more complete exploration of the phenomena.

3.2.3 Operational Definition

The nominal definition is used as a basis for generating the operational definition, and therefore, the measures used. This cascade of definitions aims to generate transparent, specific, observable and justifiable measures that are readily traceable back to the characterisation of the conceptual definition. Watkins and Marsick (2003) have included measures of cognitive, technical, social, and cultural dimensions. Redding (1997) reviewed several LO assessment measures available at the time, and found that the framework created by Watkins and Marsick (2003) was among the few that covered learning at individual, team and organisational levels. The Dimensions of Learning Organisation Questionnaire (DLOQ) developed by Watkins and Marsick (2003) is based on their model in which organisational learning occurs in these three levels (individual, team and organisational), and covers the following explicit organisational characteristics which can then be measured:

- Individual level
    - *Dialogue and inquiry*: robust discussion and asking questions.
    - *Continuous learning*: opportunities and resources for learning, training and education.
- Team level

  - *Team learning and collaboration*: support within teams for sharing information and supporting each other's learning.

- Organisational level
  - *Leadership supporting learning*: extent of leadership enables learning by practice and by resourcing.
  - *Embedded systems*: information systems access and utility.
  - *System connections*: does the organisation support broader perspectives.
  - *Shared vision and empowerment*: degree of autonomy and engagement with the organisation's vision or mission.

Goh and Richard (1997) developed the Organizational Learning Survey (OLS) by examining the commonalities within the published literature, and using Garvin's (1993) definition as a guiding construct, they extracted five common dimensions within the theoretical and empirical literature as an operational definition. For Goh and Richard's (1997) a learning organisation would exhibit the following measurable characteristics:

- *Clarity of purpose or mission*: the degree to which employees have a clear vision and understand how they engage with it.
- *Leadership commitment and empowerment*: the role of the leaders in the organisation with respect to helping employees' learn and elicit behaviours that are consistent with experimentation and changing culture.
- *Experimentation and rewards*": the degree of freedom employees enjoy in the pursuit of new ways of getting the job done and freedom to take risks.
- *Transfer of knowledge*: the systems that enable employees to learn from others, from past failures and from other organisations.
- *Teamwork and group problem solving*: the degree of teamwork possible in the organisation to solve problems and generate new and innovative ideas.

The Learning Organisational Survey (LOS) is an organisational learning tool developed by Garvin, Edmondson and Gino (2008). The LOS seeks to measure organisational learning and associated learning process. Learning factors, which when taken as a whole represent the elements of learning in an organisation include:

- *Information-sharing patterns*: the extent to which people share information.
- *Inquiry climate*": the ways and extent to which experimentation, challenge and inquiry characterise the behaviours of organisational members.
- *Learning practices*": refers to the specific activities organisational members engage in to learn.
- *Achievement mindset*: focus on results and task outcomes.

The Learning Environment Questionnaire (LEQ) developed by Armstrong and Foley (2003) is an Australian questionnaire that focuses on the structural level mechanisms

indicative of learning organisations rather than any individual characteristics that effect learning. The LEQ was not intended to identify any individual learning processes, rather, it aimed to map the underlying organisational culture, processes and structures that create and improve learning opportunities. Consequently, the LEQ has a different focus to the other learning organisation questionnaires. Such cultural and structural factors do indeed provide the context within which learning is situated and, according to Armstrong and Foley (2003), are the organisational learning mechanisms (OLM). The four categories of OLM identified by Armstrong and Foley (2003) were:

- *learning environment*
- *identifying learning and development needs*
- *meeting learning and development needs*
- *applying learning to the workplace*.

The LEQ has 12 scales to measure the four categories, which have been developed to measure the "cultural and structural facets of a learning organisation" (Armstrong &Foley, 2003, p80).

The instruments described in the Table 1 have all been based on the theoretical and empirical understanding of what constitutes a learning organisation. Each instrument has specific items associated with each measure. As an exemplar, Marsick and Watkins' (2003) DLOQ, the dimension 'dialogue and inquiry' asks to what extent does your team:

- "Give open and honest feedback"
- "Listen to other's views before speaking"
- "Are encouraged to ask 'why?' regardless of rank?"

The instruments all have a coherent theoretical link from the conceptual definition of the learning organisation to the operational measures provided within the measures. This means that the instruments do indeed provide acceptable levels of theoretical validity.

3.3 Reliability of Learning Organisation Measures

The items that are used within each of these instruments were found to possess an acceptable level of theoretical validity within their target populations. The measures focused on observable, specific and justifiable concrete behaviours. Their reliability was then evaluated using a variety of criteria, as mentioned in Section 2.1.1. The DLOQ, OLS and LEQ all have published statistical reliability, and demonstrated acceptable levels (that is, Cronbach alphas above .70).

In addition, the DLOQ and OLS have reported their discriminant validity criteria, demonstrating an acceptable level of discrimination between different populations. Goh and Richards (1997) reported on the ability of the OLS to discriminate between four very different organisations: (i) a government public-sector organisation; (ii) a high performing high-tech company; (iii) a 'qago' (a quasi-autonomous government organisation); and (iv)

a large telecommunication company (private sector). The OLS differentiated between the work practices of the four organisations, with all four organisations varying by the hypothesised direction given the theoretical understanding of organisational structure, performance and learning (with the government organisation the lowest scoring and the high-performing high-tech company having the highest scores). Also, the OLS was correlated significantly with job satisfaction across all organisations ($r=0.64$, $p<.001$), showing that supportive learning environments were linked to increased job satisfaction.

Marsick and Watkins' (2003) DLOQ has an acceptable level of reliability as reported by Yang (2003) and Yang, Marsick and Watkins, (2004). The reliability (or internal consistency) scores for Cronbach's coefficient alphas were 0.80 to 0.87 with an overall reliability of 0.96 (Yang, 2003:160). Their questionnaire comprises 55 statements concerning organisational practices which relate to learning in and by organisations. Respondents are invited to indicate the extent to which they perceive these practices occurring within their organisation by way of a six point Likert scale.

Armstrong and Foley's (2003) LEQ reported acceptable reliability levels (Cronbach's above 0.7 for all the dimensions) and also strong theoretical construct validity, however no other validity criteria were satisfied. The focus of the LEQ was different to the other Learning Organisation questionnaires; the LEQ is solely aimed at measuring the structural and cultural environment that supports learning within an organisation. That the LEQ focuses on structural and cultural level mechanisms is not a fault; however, given that the aim of the Army Learning Organisation Questionnaire is to measure learning at the individual and team levels as well as at the organisational (structural and cultural) level, the LEQ was deemed not to be sufficient.

The Organisational Learning Survey (OLS) developed by Garvin, Edmondson and Gino (2008) examines the extent to which an organisation exhibits the characteristics and behaviours associated with the following building blocks of a learning organisation: supportive learning environment; concrete learning processes and practices; and leadership behaviours that reinforce learning. These building blocks represent the three main sections of the on-line diagnostic survey instrument. Unfortunately, Garvin, Edmondson and Gino's (2008) survey instrument is not publically available, as it is only available online through the author's own website. Nor did Garvin et al (2008) report any reliability or validity data against which to evaluate their questionnaire.

Table 2: Learning Organisation questionnaires: validity and reliability criteria

Questionnaires	Scale - Reliability		Scale - Validity		
	Internal consistency	*Inter-rater reliability and agreement*	*Content validity*	*Discriminate validity*	*Statistically validated relationships to outcomes of interest*
Dimensions of Learning Organization Questionnaire (DLOQ)	Yes – reported overall coefficient alpha 0.97	None reported	Yes – Structural Equation Model (Yang, 2003) of 7 dimensions for DLOQ best fit.	Yes – reported in Yang (2003).	Yes, results of SEM reported in Yang (2003).
Organizational Learning Survey (OLS)	Yes – overall Cronbach reported 0.90	Yes – test/re-test correlation 0.77	Yes – normative/theoretical approach	Yes – discriminated between differing organisations	Yes, significantly correlated to: job satisfaction, job formalisation, profitability
Learning Environment Questionnaire (LEQ)	Yes - Cronbachs for scales reported between 0.72 and 0.92	Yes - varied between 0.22 to 0.86	Yes - Theoretical structural and cultural relationship	None reported	None reported
Learning Organization Survey (LOS)	None reported	None reported	Yes –based on Garvin's theoretical work	None reported	None reported

4. Results: Developing the Army Learning Organisation Questionnaire

Using the established method of scale development as described by Streiner and Norman (2003, 2008) the literature was reviewed for established measures. The measures were critically reviewed against specific reliability and validity criteria. All four measures were found to have a strong theoretical basis; all four were judged to have an acceptable level of content validity. The LEQ was found to not cover all the necessary organisational dimensions required for the ALOQ. Applying further criteria, acceptable information of empirical validity was reported for only two of the four instruments, with at least one criteria of validity (either discriminant or Structural Equation Modelling [SEM] or statistical construct validity). These two measures were Marsick and Watkins' (2003) DLOQ and Goh and Richard's (1997) OLS. The other two measures, LEQ and the LOS did not have any other empirical validation processes reported.

Of the four instruments, the DLOQ, OLS and the LEQ did report reliability outcomes for target populations. Of these three instruments, the DLOQ and OLS were found to be above the acceptable level of 0.70 (Nunnally, 1978). Thus, as the DLOQ and OLS were found to be reliable and valid instruments for measuring Learning Organisation

characteristics, they were selected to be adapted to the Army context. The two questionnaires' were amalgamated, their language and question construction were adapted to military and the resulting questionnaire was termed the Army Learning Organisation Questionnaire (ALOQ).

4.1 ALOQ Pre-test and Testing Process

Following Streiner and Norman's (2003; 2008) method for developing questionnaires, the items within the DLOQ and OLS were then piloted with the target population in order to ensure item (or question) clarity and comprehension. The questionnaire went through a three phase iterative pre-test process to ensure that the language was comprehensible, unambiguous and appropriate for the Army.

4.1.1 First Pretest: In-house DSTO Army Personnel

The initial pilot testing was conducted with in-house military personnel in DSTO. The military personnel completed the questionnaire, then provided their feedback on the language and the applicability of the types of questions to the Australian Army. The feedback was conducted through face-to-face interviews. The personnel were asked for their interpretation of the questions, and what they thought about when they were answering particular questions. The first pilot phase was conducted on eleven personnel. The military personnel were all either senior non-commissioned officers (WO1, WO2) or commissioned officers.

The feedback was collated, and the items were adapted based on this feedback. Most of the feedback pertained to the following areas:

- concerns/difficulties in answering "organisational performance" scales
- concerns about "corporate speak" within the questionnaire
- concerns about some of the item constructs including double-barrelled item construction[2]
- clarifying answer rating scales to match the items.

4.1.2 Second Pre-test: Land Warfare Development Centre Workshop – Army Personnel

The second pilot was conducted on 30 military personnel attending a workshop with ranks ranging from CPL to LTCOL. The questionnaire was distributed and completed prior to the workshop, and feedback provided during a workshop session.

The feedback was collated and, again, the questionnaire was amended in response to these concerns. The main issues were:

[2] An example of a double barrelled item; "I can talk to my supervisor and team-mates openly and honesty".

- concerns/difficulties in answering "organisational performance" scales
- concerns rose about whether less educated or experienced personnel would understand some of the items.

4.1.3 Third Pre-test: Soldier Interviews

The final phase of the piloting process aimed to address the concerns about how the "diggers" ("other ranks" or private soldiers) would interpret the items. Twelve face-to-face interviews were conducted, which were audio recorded, during which soldiers completed the questionnaire and were then asked what they believed the questionnaire was asking and how they answered it. For example, interviewees were asked "what did you think about when we asked about empowerment?" or "what did you understand when you answered Question Four?" Their responses were collated, and common themes were distilled. For example, "when I was asked about 'empowerment,' I was thinking if I could do what I needed to do to get a job done. Was I allowed to do things that I needed to do?"

This provided a test of construct validity, showing that when soldiers were asked items that had been identified by the previous pilot phases as being potentially difficult to understand, that, in fact, they did comprehend what was being asked of them.

Because both Phase 1 and Phase 2 personnel found it very difficult to answer questions on organisational performance measures these items were eliminated from the questionnaire including *knowledge performance* and *organisational performance* dimensions. For example "knowledge performance" included items such as "in my unit or workgroup, the number of personnel learning new skills is greater than last year" (answering from "strongly disagree" to "strongly agree") while *organisational performance* included the items "in my unit or workgroup, we completed more training this year than last year" (answering from "strongly disagree" to "strongly agree").

4.2 ALOQ Reliability and Validity

This section reports the ALOQ's reliability and validity using the criteria discussed in Section 2.1.1 (Table 2). The ALOQ is made up of the DLOQ and OLS, and in doing so, it incorporates the previous work's published reliability and validity measures. The ALOQ was administered to an Army brigade (N=390). The Cronbach alphas were then calculated from this sample. The exploratory factor analysis (EFA) was then conducted on a larger sample of Army personnel (N=3700) in order to evaluate statistical validity.

4.2.1 ALOQ Reliability

4.2.1.1 *ALOQ Internal Consistency*

The internal consistency of the ALOQ dimensions is reported in Table 3: ALOQ Cronbach alpha and all, except one, was above the recommended 0.70 level. The measure "innovation and experimentation" showed an internal consistency of 0.68 however, with the subsequent dropping of the item with the lowest item-scale correlation coefficient (i.e. Question 60: "I often bring new ideas to my workgroup or section") the measure

subsequently incorporated four items with a Cronbach alpha of 0.72. Overall, the ALOQ demonstrated acceptable level of statistical reliability.

Table 3: ALOQ Cronbach alpha

	ALOQ Measure	Modified from	Cronbach alpha
1	Continuous learning	DLOQ	0.81
2	Dialogue and inquiry	DLOQ	0.84
3	Team work and collaboration	DLOQ	0.83
4	Systems – capture and share learning	DLOQ	0.84
5	Collective vision	DLOQ	0.88
6	Connection – organisation to environment	DLOQ	0.86
7	Strategic Leadership for learning	DLOQ	0.90
8	Leadership – empowerment	OLS	0.73
9	Innovation and experimentation	OLS	0.68
10	Knowledge transfer	OLS	0.79
11	Teamwork- diversity	OLS	0.78

4.2.2 ALOQ Validity

4.2.2.1 ALOQ Content and Face Validity

Both the DLOQ and OLS were generated from within a theoretical conception of a Learning Organisation using the following process:

1. Conceptualisation: What is an ideal learning organisation? One that responds successfully to a changing environment.
2. Nominal definition: what would it look like? What makes it different from a non-learning organisation? For example, the organisation would have better quantity and quality of communication.
3. Operational definition: what exactly do we mean by "better communication is important for learning in organisations"? For example, personnel can discuss their own and other's mistakes with teams or supervisors when they need to.
4. Measures: the measure then became "to what extent can you talk about mistakes with your supervisor/s? To you teammates?"

Thus the ALOQ's content validity is firmly anchored within the theoretical literature, building on the original authors' content validation.

The benefit of the ALOQ's face validity was judged to outweigh the potential issue of social desirability bias. Face validity provides respondents with relevant questions and helps provide feedback to the main stakeholders. "Faking good" (or social desirability) is always an issue when items have face validity and, hence, should be minimised wherever possible by anonymous self-administration of questionnaires, with anonymous and confidential collection of questionnaires (Streiner & Norman, 2003; 2008). Thus, within the ALOQ, the potential social desirability bias was moderated by using anonymous

administration techniques; for example, by confidential ballot box returns and paper-pen responses.

4.3 ALOQ Statistical Analysis

The next step in investigating ALOQ validity was to conduct statistical analyses using exploratory factor analysis (EFA) in order to empirically investigate the applicability of the original authors' model of learning organisation to Australian Army data.

4.3.1 Participants

The data set was collected from 3,895 respondents of the ALOQ. This included data from 3275 Regular Army and 552 Reservists. Respondents were deleted list-wise[3] if they left greater than 1/3 of the items unanswered. Valid respondents represented 96% of all respondents – a loss of 4% of respondents.

Of the 3,724 valid respondents, 91% of the sample was male, and 38% were between 18 and 25 years old. The majority (66%) of personnel were ORs (other ranks), 17% were NCOs and 15% were commissioned officers.

4.3.2 Treatment of missing data

As noted above, 103 cases were deleted list-wise due to missing data. Of the remaining 3,724 valid respondents there was a small proportion of unanswered questions. A Full Information Maximum Likelihood (FIML)[4] method was used to estimate replacement values for the missing data.

4.3.3 Exploratory factor analysis (EFA) of ALOQ

The total of 44 items (made up of 43 items developed by Marsick and Watkins (2003) with one additional Army-specific item) together with the 21 items developed by Goh and Richards (1997) were used in the EFA. Both item sets (44 items and 21 items) were theoretically measuring eleven underlying constructs (see Appendix A). Exploratory factor analysis (EFA) was conducted on the two datasets in order to evaluate the two different theoretical constructs, both Yang, Marsick and Watkins' (2004) and Goh and Richard's (1997) models. The aim was to investigate to what extent Army's data aligned with these specific theoretical models in order to assess their validity; consequently the two data sets were analysed separately. There is a large theoretical overlap between both models' and this interaction is planned to be investigated further in further reports.

[3] List-wise deletion is a method for handling missing data; in this case, if 1/3rd or more of a respondent's data was missing, then their entire record was excluded from the analysis.
[4] FIML Full Information Maximum Likelihood estimation method utilises all available information from the data when there is a high proportion of observations with random missing values.

EFA considers the correlations between all of the measures under consideration and asks the question, "Are there subsets of measures where, for each subset, the measures are highly correlated with each other, but are not correlated with any of the other measures?" If such subsets are found, it is assumed they are measuring the same common underlying construct. The following sections describe this analysis.

4.3.3.1 Checking correlations and commonalities

The first step in the EFA was to determine to what extent the items (or variables) are correlated to each other. The adequacy of the correlations' magnitude was initially tested by using Kaiser-Meyer-Oklin (KMO) (Kaiser, 1974) and Bartlett's test of sphericity (see Table 4).

Table 4: EFA assumption testing of ALOQ: Adequacy of correlation strength

Assumption tests	**44 item set***	**21 item set**
KMO measure of sampling adequacy	0.97	0.94
Barlett's test of sphericity		
Approx chi-square	98210.326	25899.448
DF	946	136
Significance	P <.0001	P <.0001

* The 44 item set was made up of Marsick and Watkin's (1996) 43 items plus one Army specific item.

The KMO statistic measures whether the correlations between pairs of variables can be explained by other variables – a necessary condition to support the existence of an underlying factor structure. Kaiser (1974) described KMO factors greater than 0.9 as *marvellous*, and values less than 0.5 as *unacceptable*. The KMO for DLOQ and OLS item sets are over 0.9 indicating that the pairs of variables are strongly explained by other variables; there is a factor structure to the data.

Bartlett's test of sphericity indicates to what extent the correlation matrix differs significantly from an identity matrix; are the relationships between the variables amenable to modelling using Structural Equation Modelling (SEM)? A very large Chi-square for both DLOQ and OLS items with p values of less than .001 indicates that the data does indeed differ significantly from an identity matrix and, thus, there are significant correlations overall between the variables.

Another means of assessing the strength of the linear association is to look at the variance explained in each variable by either all variables or by the extracted factors. A squared multiple correlation coefficient (R^2) is a measure of this variance and is called a communality in EFA. An initial communality is the variance explained in a single variable by all other variables; extraction communality is the variance explained in a single variable by the extracted factors. A low communality (usually below 0.3) suggests that the variable may have little to do with the other variables and therefore may be dropped from the analysis. The communalities for the ALOQ are shown in Table 10: ALOQ communalities in Appendix A. The communalities show that the variation within the data can be explained by underlying constructs.

4.3.3.2 ALOQ Factor extraction, Eigen Values, Scree Plots and the Factor Matrix

A number of factors were extracted to adequately describe the measures. Choosing the most appropriate extraction method and determining the correct number of factors needs some consideration. To evaluate the options available, it is first necessary to understand the aim of this activity. The differences amongst the extraction methods published can be explained by their objectives (Pallant, 2007; Holmes-Smith, 2012); for example, Principle component (PC) extraction aims to generate linear combinations of variables so that the variance of the first factor and each subsequent orthogonal combination is maximised. In Maximum likelihood (ML) extraction, the objective is to find the linear combination of variables such that when the first, and subsequent orthogonal combination, are used to reproduce the sample correlation matrix, the difference between the reproduced correlation matrix and the observed sample correlation matrix is minimised.

Fabrigar et al. (1999) recommend the use of Maximum Likelihood (ML) extraction if there are no concerns with data distribution, for example, no significant skewness and kurtosis. Inspecting the 44 items showed that the data were only mildly skewed (values ranging from -0.250 to 0.480) and kurtosis was mild (values range from -0.554 to 0.127) so ML extraction was used. Regardless of the extraction method, if all the measures are expressed in a standardised form, for example, a mean of zero with a standard deviation of one, then the total variance will equal the number of measures. It then becomes possible to calculate how much of the total variance is accounted for by each factor (Table 11: Variance explained (Eigen values) for 44 item data set). The first factor explains a total of 43% of the total variance (18.9 of a total variance of 44). The second has an Eigen value of 2.1 (of a total of 44) and explains 4.8% of the total variance.

There are two main methods for selecting the number of factors; first, to select all those factors with an Eigen value greater than one and is known as Kasier's criterion (Pallant, 2007) and the second uses Catell's scree test (Cattell, 1966), which uses a plots the Eigen value against the number of factors in determining the cut off factor (Cattell, 1966). Using Catell's scree test counters the criticisms of using Kraiser's criteria (Pallent, 2007). Kraiser's criterion has been criticised for a lack of stringency; that is, retaining too many factors. Catell's scree test provides a more informed selection. Using the scree plot method recommended by Cattell (1966) a nine factor solution was initially forced[5] onto this analysis for the 44 item data set. Upon inspection of the results, the ninth factor was found to be a *single item* so the factors were reduced to eight (Table 5). A single item factor is not suitable for further analysis. For the 21 item data set, the scree plot method also found that six factors best described the data; hence a six factor solution was initially forced onto the analysis. The factors were then rotated allowing for easier interpretation. There are a number of different rotation methods available; an oblique rotation should be used if there is a theoretical reason for the factors to be correlated. The factors have been shown to be correlated (KMO statistic was over 0.90) so a Promax Rotation[6] was performed. SPSS produces a separate pattern matrix (containing the factor loadings showing how much weight are assigned to each factor) and a structure matrix (containing the correlations between the factors and the variables). The pattern matrix of the 44 items loading onto eight factors is shown in Table 5 while the pattern matrix for the 21 item data set is shown in Table 6.

Table 5- ALOQ 44 item pattern matrix showing eight factor loading solution

	Factor							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Q1			0.811					
Q2			0.807					
Q3			0.498					
Q4								0.377
Q5								0.472
Q6			0.471					
Q7								0.726
Q8			0.386	0.366				
Q9				0.644				
Q10				0.386				
Q11				0.562				
Q12				0.869				
Q13				0.660				
Q14								
Q15							0.633	
Q16							0.743	
Q17							0.616	
Q18							0.360	0.514
Q19	0.519							0.343
Q20	0.469							
	Factor							

[5] "Forcing" is the technical term for specifying the number of factors desired within the factor analysis solution.

[6] Promax rotation is a non-orthogonal (oblique) rotation method which is computationally faster than the direct oblimin method and thus is more useful for large data sets.

	1	2	3	4	5	6	7	8
Q21	0.309					0.382		
Q22						0.721		
Q23						0.561		
Q24						0.409		
Q25						0.344		
Q26	0.565							
Q27	0.836							
Q28	0.840							
Q29	0.739							
Q30	0.889							
Q31	0.637							
Q32								
Q33					0.436			
Q34					0.684			
Q35					0.516			
Q36					0.648			
Q37					0.536			
Q38					0.373			
Q39		0.520						
Q40		0.757						
Q41		0.633						
Q42		0.932						
Q43		0.855						
Q44		0.609						

Table 6 - ALOQ 21 items pattern matrix showing six factor loading solution

	Factor					
	1	**2**	**3**	**4***	**5**	**6**
Q45				0.691*		
Q46	0.510					
Q47	0.623					
Q48	0.932					
Q59		0.589				
Q49	0.587	0.302				
Q50	0.429					
Q51				0.669*		
Q60		0.534				
Q61		0.708				
Q52						0.717
Q53						0.628
Q54			0.700			
Q55			0.846			
Q56					0.575	
Q57					0.490	
Q58		0.343				

*Factor is a method effect due to negatively worded items therefore this factor is discounted from further analyses.

The exploratory factor analysis of the ALOQ found underlying factors that emerged from our target respondents that instead of the Marsick and Watkins' (2003) seven factors, we found that there were eight factors emerging from our data. In line with the Goh and Richard's (1997) original items, four items were also found within the EFA.

The ALOQ, based on the results of the EFA, generally aligns well with the established evidence of measuring learning within organisations. However one difference was found within our data compared to DLOQ; the *continuous learning practices* dimension was separated into two, *resources and rewards* and *learning practices*. This result may well reflect the differences within the Army's organisational structure and processes compared to the organisations considered during DLOQ development; for example, that rewards and resources are seen as being controlled centrally in Army and thus are not reflective of individual's perceptions of their own teams or particular work environments. More detailed results from the EFA are presented in Appendix A.3.

Six factors were initially found within the data, in comparison to Goh and Richard's (1997) originally hypothesised five factors. Inspecting the pattern matrix showed that Q45 and Q51 (the two negatively worded items) were in fact loading onto one factor (Factor 4); this indicates that this loading is a method effect (the detected co-variation due to being negative phrased). Consequently, this factor (Factor 4) was discounted. The exploratory factor analysis of the ALOQ found that were five underlying factors that emerged from our target respondents in line Goh and Richard's (1997) five factor model (Table 7).

Table 7: ALOQ EFA emergent factors

	ALOQ Measure	**From**		**ALOQ EFA factor**
1	Continuous learning	DLOQ	1.1	Learning practices
			1.2	Resources and rewards
2	Dialogue and inquiry	DLOQ	2.1	Dialogue and inquiry
3	Team work and collaboration	DLOQ	3.1	Teamwork
4	Systems – capture and share learning	DLOQ	4.1	Systems to capture and share learning
5	Collective vision	DLOQ	5.1	Collective vision
6	Connection - organisation to environment	DLOQ	6.1	Connection - organisation to environment
7	Strategic leadership for learning	DLOQ	7.1	Strategic leadership for learning
8	Leadership – empowerment	OLS	8.1	Leadership – empowerment
9	Innovation and experimentation	OLS	9.1	Innovation and experimentation
10	Knowledge transfer	OLS	10.1	Knowledge transfer
11	Teamwork and diversity	OLS	11.1	Teamwork and diversity

The EFA demonstrates that the underlying commonality within the ALOQ items are determined by the twelve latent factors in Table 7, which align with the theoretical constructs found within the literature.

4.4 Summary of ALOQ reliability and validity

The theoretical and statistical analysis of the ALOQ demonstrates that it is a valid and reliable measure of learning organisation characteristics. The ALOQ conforms to the acceptable standards within the psychometric literature (Table 8). The ALOQ has acceptable levels of internal consistency (Cronbach's alpha) yet not excessive levels (above 0.90) that may indicate overly correlated factors (Streiner & Norman, 2003; 2008). Also, the results from the EFA indicate that the hypothesised factors within Marsick and Watkins (2003) and Goh and Richards (1997) are supported within our data set, with a slight

variation for one DLOQ factor loading into two. The underlying factors are consistent with published literature on organisational learning factors and thus support the construct validation of the ALOQ with its target respondents.

Table 8: ALOQ validity and reliability

	ALOQ Measure	**Modified from**	**ALOQ Internal reliability (Cronbach alpha)**	**ALOQ - Test-retest reliability**	**ALOQ Content validity**	**ALOQ - Discriminant validity**	**ALOQ - Validated relationships to outcomes of interest**	**ALOQ – EFA results**
1	Continuous learning	DLOQ	0.81	DLOQ None reported	Yes- developed from theoretical basis; cognitive interviews during pilot process	DLOQ – discriminated between different organisational types	DLOQ; correlated to financial performance and knowledge performance of organisations.	2 factors: Learning practice, rewards and resources
2	Dialogue and inquiry	DLOQ	0.84					Single factor
3	Team work and collaboration	DLOQ	0.83					Single factor
4	Systems – capture and share learning	DLOQ	0.84					Single factor
5	Collective vision	DLOQ	0.88					Single factor
6	Connection - organisation to environment	DLOQ	0.86					Single factor
7	Strategic leadership for learning	DLOQ	0.90					Single factor
8	Leadership and empowerment	OLS	0.73	OLS; correlation of 0.77		OLS; discriminated between differing organisations	OLS; correlated to organisational commitment, job satisfaction	Single factor
9	Innovation and experimentation	OLS	0.72*					Single factor
10	Knowledge transfer	OLS	0.79					Single factor
11	Teamwork and diversity	OLS	0.78					Single factor

*Note that one item was removed from original measure, which lead to an increase from 0.68.

The ALOQ can be used confidently to measure the characteristics of learning organisations, especially of military organisations. Given the rigorous grounding, pretesting and statistical analysis of the ALOQ, valid conclusions can be drawn about what exactly the questionnaire is measuring; including the underlying factors such as team communication, leadership, knowledge transfer and generation, and learning practices.

5. Conclusions

The existing instruments (DLOQ, OLS, LOS and LEQ) all provided theoretically based measures of the characteristics of learning organisations. The measures were found to be both valid and statistically reliable. Thus, the DLOQ and OLS have provided a useful basis upon which to build the ALOQ. The available measures were adapted for use within the Army, such as changing the items' wording using an iterative test-retest process. The subsequent instrument, named the ALOQ, was administered to a sample of the target population. Statistical analysis was conducted, examining the internal consistency (Cronbach alpha's) of the ALOQ and it was found to have satisfactory level of statistic reliability.

The theoretical validity of the ALOQ was examined using the nomological process described by Babbie (1995) and Streiner and Norman (2003, 2008). The ALOQ was developed from instruments found to be firmly anchored within the theoretical underpinnings of a Learning Organisation. The exploratory factor analysis evaluated the underlying commonality within the items, and found a very similar structure to those proposed by both Marsick and Watkins (2003) and Goh and Richards (1997). The 44[7] items derived from the DLOQ loaded onto eight factors, rather than Marsick and Watkin's (2003) original seven factors. The DLOQ factor "creating continuous learning opportunities" was found, within the Army sample, to load onto two separate factors. These were "resources and rewards" and "learning practices". This difference to Marsick and Watkins' (2003) findings may reflect the centralisation of the Army as an organisation, particularly in terms of control over resource allocation. All the other factors described by Marsick and Watkins' (2003) and Goh and Richard's (1997) were found within our sample. These finding show that the ALOQ does measure the underpinning factors within an organisation that determine the quality of learning within organisations.

In conclusion, the ALOQ was designed to measure Learning Organisation characteristics within the Australian Army. The ALOQ was adapted from the most reliable and valid measures of learning organisations available in the literature, the DLOQ and OLS. The ALOQ underwent a rigorous process of testing and evaluation to ensure its reliability and validity. Using data collected by the ALOQ, we can determine measures the underlying factors that influence learning within the Army and the information to underpin decisions relating to organisational change.

[7] The original 43 DLOQ items plus an additional Army-specific question makes up the 44 item set.

6. References

American Educational Research Association, American Psychological Association, and National Council of Measurement on Education (1999). *Standards for educational and psychological testing.* American Educational Research Association. Washington, DC.

Armstrong, A., and Foley, P. (2003). Foundations for a learning organization: organization learning mechanisms. *The Learning Organization, 10*(2):74-82.

Argyris, C. (1993). *On Organizational Learning,* Blackwell Publishers, Cambridge Massachussets

Australian Army, (2007). The Australian Army – A learning organisation, [Accessed 22 December 2010]; Available from: http://intranet.defence.gov.au/armyweb/sites/DGDP/comweb.asp?page=3242&Title=Publications/Orders#AdaptiveCampaigning

Babbie, E. (1995) *The Practice of Social Research*, 7th Edition. Wadsworth Publishing: Belmont, California.

Campbell, D. T. (1960). Recommendations for APA test standards regarding construct, trait or discriminant validity. *American Psychologist,* 15, 546-553.

Carmines, E. G., and Zeller, R. A. (1979) *Reliability and Validity Assessment.* In J. L. Sullivan (Series Ed.): Vol. 17. Thousand Oaks, California: Sage.

Cattell, R.B. (1966) *Handbook of Multivariate Experimental Psychology*. Chicage: Rand McNally.

Cook, D., and Beckman, T. J. (2006). Current concepts in validity and reliability for psychometric instruments: Theory and application. *The American Journal of Medicine*, 119, 166.e167-166.e116.

Clark, L.A., and Watson, D. (1995) Constructing validity; Basic issues in objective scale development. *Psychological Assessment*, 7, 309-919.

Cronbach, L.J. (1951) Coefficient alpha and the internal structure of tests. *Psychometrika* 16(3):297-334.

Cronbach, L. J., and Meehl, P. E. (1955). Construct validity in psychological tests. *Psychological Bulletin,* 52(4), 281-302.

De Vellis, R.F. (2003) *Scale Development: Theory and applications*. (2nd Ed). Thousand Oaks, California; Sage.

Drobnjak, M., and Stothard, C. (2011). *Measuring an Army Units' Learning Organisation Characteristics, Attitudes towards Organisational Change and Organisational Trust*. Paper presented at the Australian Industrial and Organisational Psychology Conference. Brisbane.

Edmondson, A. C. (1999). Psychological safety and learning behavior in work teams. *Administrative Science Quarterly*, 44(2), 350-383.

Edmondson, A. C. (2004). Psychological Safety, Trust, and Learning in Organizations: A Group-Level Lens. In R. M. Kramer & K. S. Cook (Eds.), *Trust and distrust in organizations: Dilemmas and approaches* (Vol. X, pp. 239-272). NY, US: Russell Sage Foundation.

Edwards, A.L. (1957). *The social desirability variable in personality assessment and research*. New York: Dryden.

Fisher, R. (1925) "Theory of statistical estimation" Proceedings of the Cambridge *Philosophical Society*, 22: 700–725

Fabrigar, L.R., Wegener, D.T., MacCallum, R.C., and Strahan, E.J. (1999) Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods* 4(3):272-299

Garver, M. S., and Mentzer, J. T. (1999). Logistics research methods: Employing structural equation modelling to test for construct validity. *Journal of Business Logistics*, 20(1), 33-57.

Garvin, D.A. (1993) Building a learning organization. *Harvard Business Review*, March, 109-116:

Garvin, D. A., Edmondson, A.C., and Gino, F. (2008) Is yours a Learning Organisation?, *Harvard Business Review,* 71(4):78–91.

Goh, S. C. (2001). The learning organization: An empirical test of a normative perspective. *International Journal of Organizational Theory and Behaviour*, 4:329-355.

Goh, S. C., and Richards, G. (1997). Benchmarking the learning capability of organizations. *European Management Journal*, 15(5):575-583.

Gravetter, F. J. and Forzano, L-A. B., (2009) *Research Methods for the Behavioural Sciences,* 3rd Edition. Wadsworth, Cengage Learning.

Guion, R.M. (1977) Content validity: Three years of talk-what's the action? Public Personnel Management. 6:407-414.

Hancock, G. R., and Mueller, R. O. (2001). Rethinking construct reliability within latent variable systems. In R. Cudeck, S. du Toit, & D. Sörbom (Eds.), *Structural Equation Modeling: Present and Future — A Festschrift in honor of Karl Jöreskog.* Lincolnwood, IL: Scientific Software International, Inc.

Holmes-Smith, P. (2011) *Structural Equation Modelling (using AMOS): From fundamentals to advanced topics.* SREAMS; Melbourne, VIC.

Kline, P. (1986), A handbook of test construction: Introduction to psychometric design, Methuen, New York.

Marsick, V. J., and Watkins, K.E. (1994). The learning organization: An integrative vision for HRD. *Human Resource Development Quarterly,* 5(4):353-360.

Marsick, V. J., and Watkins, K. E. (2003). Demonstrating the Value of an Organization's Learning Culture: The Dimensions of the Learning Organization Questionnaire. *Advances in Developing Human Resources*, 5(2):132

Muchinsky, P. M. (1996). The correction for attenuation. *Educational and Psychological Measurement*, *56*(1), 63-75.

Newton, T. (2010) *Examination of the alignment between Learning Organisation and Army values: Implications for change initiatives*. Thesis submitted for MA (Org Psych): School of Psychology, University of Adelaide.

Nunnally, J.C. Jnr. (1978) *Psychometric Theory* (2nd Ed) McGraw-Hill, New York.

Pallant, J. (2007) *SPSS Survival Manual*. Open University Press, McGraw Hill; Maidenhead, UK.

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., and Podsakoff, N. P. (2003). Common method biases in behavioural research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879-903.

Redding, J. (1997). Hardwiring the learning organisation. *Training and Development*, 51(8):61-73

Rushton, J. P., Brainerd, C. J., and Pressley, M. (1983). Behavioral development and construct validity: The principle of aggregation. *Psychological Bulletin,* 94(1), 18-38.

Sackmann, S. A., Eggenhofer-Rehart, P. M., and Friesl, M., (2009) 'Sustainable Change: Long-term Efforts Toward Developing a Learning Organization', *Journal of Applied Behavioural Science*, 45:521–49.

Senge, P. M., (1990) *The Fifth Discipline: The Art and Practice of the Learning Organization*, Doubleday/Currency, New York,

Schein, E. H. (1993) *Organisational Culture and Leadership*, 2nd Ed., Jossey-Bass Publishers, San Francisco.

Smith, T.W. (1990) Phone home? An analysis of household telephone ownership. *International Journal of Public Opinion Research* 2:369-390.

Stevens, S. S., (1946) On the theory of scales and measurement, *Science*, 103:677-680.

Stothard, C.F. and Drobnjak, M. (2009). Working relationships in the Australian Army: Applying a social capital framework to social information networks. Paper accepted into the *Proceedings of the 44th Annual Conference of Australian Psychological Society*, Darwin, November, 2009. pp 173-178.

Stothard, C.F. and Drobnjak, M. (2009a). *How to win friends and influence people: Social capital, social networks and organisational learning in the Army.* Paper presented at the Defence Human Sciences Symposium, DSTO Melbourne, September, 2009.

Streiner, D.L., and Norman, G.R. (2003) *Health measurement scales; A practical guide to their development and use*. 3rd Edition. Oxford University Press; Oxford, UK.

Streiner, D.L., and Norman, G.R. (2008) *Health measurement scales; A practical guide to their development and use*. 4th Edition. Oxford University Press; Oxford, UK.

Talbot, S. (2006). *Organisational Learning in the Australian Army: A sociological examination of Lesson Learning Processes and Infrastructures* (Technical report No. DSTO-TR-1839). Edinburgh SA: Defence Science and Technology Organisation.

Talbot, S., Drobnjak, M., Stothard, C.F. and McDowall, D. (in preparation) *Army as a Learning Organisation: Literature review.* DSTO-TN-XXX Edinburgh, SA: Defence Science and Technology Organisation.

Talbot, S., Fidock, J., Drobnjak, M. and Stothard, C. (2007). *Social and organisational learning in the Army.* Paper presented at the Defence Human Sciences Symposium, 2007: Melbourne.

Talbot, S., and O'Toole, P. (2008). *Resourceful interactions: Social capital, networking and learning in the Australian Army*. Paper presented at the 5th International Conference on Information Capital and Knowledge Management.

Watkins, K., and Marsick, V. J (1996). Individuals who learn create organizations that learn. *New Directions for Adult and Continuing Education*, (72), 97-104.

Watkins, K. E. and Marsick,V. J. (1997), *Dimensions of the Learning Organization Questionnaire* (Survey), Warwick, RI: Partners for the Learning Organization.

Weiner, H., and Braun, H. (Eds.). (1988). *Test validity.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Yang, B. (2003). Identifying valid and reliable measures for Dimensions of a Learning Culture. *Advances in Developing Human Resources*, 5(2):152-162.

Yang, B., Watkins, K. E., and Marsick, V. J. (2004). The construct of the Learning Organization: Dimensions, Measurement and Validation. *Human Resource Development Quarterly,* 15(1):31-55.

Appendix A: ALOQ EFA results

A.1. ALOQ items

Table 9: ALOQ 44 item and 21 item dataset

Construct	Item#	Item
Create continuous learning opportunities	1	We openly discuss mistakes in order to learn from them
	2	We Identify skills we need for future work tasks
	3	We help each other learn
	4	We can get money and other resources to support our learning
	5	We are given time to learn
	6	We view problems in our work as an opportunity to learn
	7	We are rewarded for learning
Promote inquiry and dialogue	8	We give open and honest feedback to each other
	9	We listen to others' views before speaking
	10	We are encouraged to ask 'why' regardless of rank
	11	Whenever we state our views we also ask what others think
	12	We treat each other with respect
	13	We spend our time building trust with each other
Encourage collaboration and team learning	14	Workgroups/Sections have the freedom to change their goals as needed
	15	Workgroups/Sections treat members as equals regardless of rank, culture or any other differences
	16	Workgroups/Sections focus both on the group's task and on how well the group is working
	17	Workgroups/Sections change their thinking as a result of group discussions
	18	Workgroups/Sections are rewarded for their achievements as a team or group
	19	Workgroups/Sections are confident that Army will act on their suggestions
Establish systems to capture and share learning	20	Army uses two-way communications regularly (e.g. suggestion systems, open meetings)
	21	Army lets us get the information required to do our jobs quickly and easily
	22	Army maintains an up-to-date profile of our qualifications
	23	Army measures gaps between current and expected performance
	24	Army makes lessons learnt available to all its people
	25	Army seeks feedback from its people on the effectiveness of training courses
Empower people to a collective vision	26	Army recognises its people for taking initiative
	27	Army gives its people choices in their work assignments
	28	Army asks its people to contribute to its vision
	29	Army gives its people control over the resources they need to accomplish their work
	30	Army supports people with innovative work practices
	31	Army allows all ranks and groups to have a say in Army's vision
Connect the organisation to its environment	32	Army helps its people to balance work and family life
	33	Army encourages its people to think about the global perspective
	34	Army encourages its people to think about Army's image when making decisions
	35	Army considers the impact of decisions on morale
	36	Army works with communities to meet both Army's and communities' needs
	37	Army encourages its people to seek advice from different parts of Army when solving problems
	38*	Army allows its people to informally discuss problems and seek advice outside their unit*
Provide strategic leadership for learning	39	Supervisors generally support requests for learning opportunities and training
	40	Supervisors share information quickly and easily
	41	Supervisors empower their subordinates to help carry out Army's vision
	42	Supervisors mentor and coach those they lead
	43	Supervisors continually look for opportunities to learn
	44	Supervisors ensure that all actions are consistent with Army's values

*Army-specific item.

Construct	Item#	Item
Leadership commitment and empowerment	45	Senior leaders resist change and are afraid of new ideas
	46	Senior leaders share a common vision with each other of what our work should accomplish
	47	We are given opportunities to provide feedback to our superiors
	48	Supervisors often provide useful feedback that helps to identify potential problems and opportunities
	59	Supervisors frequently involve subordinates in important decisions
Experimentation and rewards	49	Supervisors encourage team members to experiment in order to improve work processes
	50	Innovative ideas are often rewarded by supervisors
	51	New ideas from subordinates are not treated seriously by supervisors
	60	I often bring new ideas to my Workgroup/Section
	61	People who are new are encouraged to question the way things are done
Transfer of knowledge	52	I often have an opportunity to talk to others about why tasks either succeeded or failed
	53	Failures are discussed constructively
	54	New work processes that may be useful across Army are shared with all appropriate workers
	55	We have a system that allows us to learn successful practices from other organisations
Teamwork and group problem solving	56	We often approach our supervisors for guidance with a problem
	57	We can usually form informal groups to solve problems
	58	Most problem-solving features people from a variety of groups

A.2. ALOQ communalities

Table 10: ALOQ communalities – 44 items and 21 item data sets

	Initial	Extraction
Q1	.505	.530
Q2	.550	.595
Q3	.522	.551
Q4	.422	.404
Q5	.486	.490
Q6	.514	.552
Q7	.523	.496
Q8	.484	.505
Q9	.511	.564
Q10	.462	.488
Q11	.555	.599
Q12	.559	.566
Q13	.581	.565
Q14	.477	.472
Q15	.454	.476
Q16	.611	.666
Q17	.546	.579
Q18	.546	.549
Q19	.547	.566
Q20	.503	.493
Q21	.539	.547
Q22	.388	.452

	Initial	Extraction
Q23	.492	.547
Q24	.479	.520
Q25	.397	.404
Q26	.605	.575
Q27	.546	.569
Q28	.525	.510
Q29	.540	.541
Q30	.616	.616
Q31	.510	.510
Q32	.432	.401
Q33	.491	.503
Q34	.368	.442
Q35	.538	.567
Q36	.494	.556
Q37	.584	.580
Q38	.502	.467
Q39	.553	.550
Q40	.621	.649
Q41	.633	.654
Q42	.682	.753
Q43	.686	.726
Q44	.587	.616

	Initial	Extraction
Q45	.215	.187
Q46	.231	.217
Q47	.516	.560
Q48	.576	.602
Q59	.476	.490
Q49	.553	.595
Q50	.521	.562
Q51	.216	.180
Q60	.168	.234

	Initial	Extraction
Q61	.349	.342
Q52	.445	.434
Q53	.542	.543
Q54	.531	.695
Q55	.499	.580
Q56	.379	.394
Q57	.413	.474
Q58	.374	.412

Table 11: Variance explained (Eigen values) for 44 item data set

Factor	Initial Eigenvalues	% of Variance	Cumulative %
1	18.921	43.002	43.002
2	2.095	4.761	47.763
3	1.693	3.847	51.610
4	1.290	2.932	54.542
5	1.103	2.507	57.049
6	1.066	2.423	59.472
7	.958	2.177	61.649
8	.869	1.976	63.625
9	.801	1.820	65.445
10	.708	1.609	67.054
11	.702	1.595	68.649
12	.679	1.543	70.192
13	.663	1.506	71.699
14	.618	1.405	73.104
15	.584	1.327	74.431
16	.547	1.243	75.674
17	.546	1.240	76.914
18	.519	1.180	78.094
19	.501	1.139	79.233
20	.485	1.101	80.334

A.3. EFA results

The results from the EFA shows that the 44 interrelated variables can be reduced to eight factors, rather than the seven hypothesised by Marsick and Watkins (2003). The results of pattern matrix suggest the following:

1. The first of Marsick and Watkins' (2003) constructs ("Create continuous learning opportunities") is comprised of two sub-components, namely, Q1, Q2, Q3 and Q6 which load onto Factor 3 in the Pattern Matrix and Q4, Q5 and Q7 which load onto Factor 8 in the Pattern Matrix. Items Q1, Q2, Q3 & Q6 reflect "Learning practices" (Q1: "we openly discuss mistakes …"; Q2: "We identify skills we need …"; Q3: "We help each other to learn"; Q6: "We view problems … as opportunities to learn") whereas

Q4, Q5 & Q7 reflect perceptions of "Resourcing & Rewards" (Q4: "We get money and other resources to support our learning"; Q5: "We are given time to learn"; Q7: "We are rewarded for learning"). These items will probably need to be treated as two separate factors, namely, "**Learning Practices**" (Q1, Q2, Q3 & Q6) and "**Resourcing and Rewards**" (Q4, Q5 & Q7).

2. Items Q8 – Q13 load onto one factor (Factor 4 in the Pattern Matrix) which supports the existence of Marsick and Watkins' (20030 second construct ("Promote inquiry and dialogue"). Note, however, that Q8 and Q10 load only weakly on the factor and a reading of Q12 and Q13 suggest that these items are different to the others four. The weak loading for Q10 ("We are encouraged to ask 'why' regardless of rank") is not surprising given that most respondents indicated that this "Almost never" or "Rarely" occurred which was in contrast to the positive "Often" and "Very often" responses to the other five items measuring this construct.

3. The third of Marsick and Watkins' (2003) constructs ("Encourage collaboration and team learning") were measured by items Q14 – Q19. However, these items do not all load onto a single factor. Items Q15, Q16 & Q17 load strongly onto one factor (Factor 7 in the Pattern Matrix) and these are most closely associated with collaboration and team learning (Q15: Workgroups treat members as equals …"; Q16: "Workgroups focus … on how well the group is working"; Q17: Workgroups change their thinking as a result of group discussion"). Item Q14 loads on none of the factors and should probably be dropped. Item Q18, which talks about "rewards", loads more on Factor 8 in the Pattern Matrix which was the "Resourcing and rewards" factor which includes Q7: "We are rewarded for learning". Item Q19, which talks about Army acting on the work-groups' suggestions, loads more on Factor 1 in the Pattern Matrix which is about Army's collaborative vision.

4. The fourth of Marsick and Watkins' (2003) constructs ("Establish systems to capture and share learning") were supposedly measured by items Q20 – Q25. Reading of the items suggests two aspects of the factor. Items Q22, Q23 and Q25 are about systems Army has in place to track learning (Q22: "Army maintains an up-to-date profile of qualifications"; Q23: Army measures gaps between current and expected performance"; Q25: "Army seeks feedback … on the effectiveness of training courses") whereas items Q20, Q21 and Q24 are about ways in which Army shares learning (Q20: "Army uses two-way communication …"; Q21: Army lets us get the information required to do our jobs …"; Q24: "Army makes lessons learnt available to all its people").

5. Items Q26 – Q31 load onto one factor (Factor 1 in the Pattern Matrix) which supports the existence of Marsick and Watkins' (2003) fifth construct ("Empower people towards a collaborative vision"). Items Q26, Q29 and Q30 are about recognising initiative and supporting innovation (Q26: "Army recognises its people for taking initiative"; Q29: Army gives its people control … to accomplish their work"; Q25: "Army supports people with innovative work practices") whereas items Q28 and Q31 are about Army's collective vision (Q20: "Army asks its people to contribute to its vision"; Q31: Army allows all .. to have a say in Army's vision"). Remember also that

item Q19 loaded onto this factor and is related to a collective vision in that it talks about Army acting on suggestions. Item Q27 is very different in that it talks about choice in work assignments.

6. Items Q32 – Q38 load onto one factor (Factor 5 in the Pattern Matrix) which supports the existence of Marsick and Watkins' (2003) sixth construct ("Connect the organisation to its environment"). However, a close reading of the items suggests two factors with one item needing to be dropped. Items Q33, Q34, Q35 and Q36 are about Army's concerns with connecting to the external world (Q33: "Army encourages its people to think about the global perspective"; Q34: Army encourages its people to think about Army's image …"; Q36: "Army works with communities to meet both Army's and communities' needs") whereas items Q37 and Q38 are about seeking external advice (Q37: "Army encourages its people to seek advice from different parts of Army …"; Q38: "Army allows its people to informally …seek advice outside of their unit"). Item Q58 from the Goh and Richards (date) "Learning Capability of Organizations" scale (Q58: "Most problem-solving features people from a variety of groups") also appears to be closely related to Items Q37 and Q38 and may need to be included here. The weak loading for item Q32 ("Army helps its people balance work and family life") is not surprising because it is quite different in nature to the connectedness to the external world and the seeking external advice items.

7. The seventh of Marsick and Watkins' (2003) constructs ("Provide strategic leadership for learning") also appears to hold items Q39 – Q44 all loading onto one factor (Factor 2 in the Pattern Matrix). However, a reading of the items suggests two aspects of the factor. Items Q42, Q43 and Q44 are about actions supervisors take (Q42: "Supervisors mentor and coach"; Q43: Supervisors continually look for opportunities to learn"; Q44: "Supervisors ensure all actions are consistent with Army's values") whereas items Q39, Q40 and Q41 concern subordinates perception about how they are lead (Q39: "Supervisors generally support requests for learning opportunities and training"; Q40: "Supervisors share information …"; Q41: "Supervisors empower their subordinates to carry out Army's vision").

The EFA shows that the relationships amongst the 21 item data set variables are more complex than the four factor solution hypothesised by Goh and Richards. An initial study of the pattern matrix suggests that items Q45 and Q51 (the two negatively worded items) load onto one factor (Factor 4 in the Pattern Matrix). This factor is clearly a simple method factor. Given that the communalities for these two items were extremely low it is clear that these two items consisted of measurement error, and thus, should be dropped and the analysis re-run. A study of the pattern matrix suggests that there were in fact four factors:

1. Items Q46 – Q48 load onto one factor (Factor 1 in the Pattern Matrix) but Q59 which is also meant to be a measure of "Leadership Commitment and Empowerment" loads on a different factor. Items Q47, Q48 and, to a lesser extent, Q46 are about feedback up to and back from superiors (Q47: "We are given opportunities to provide feedback to superiors"; Q48: "Superiors often provide useful feedback …"). Item 59 is quite different (Q59: "Superiors frequently involve subordinates in important decisions") and probably should be omitted from this

factor. Therefore, three of these items will probably need to be treated as a "Feedback" factor (Q46, Q47 & Q48) with the possibility of Q59 loading onto another factor.

2. Although the Pattern Matrix suggests that item Q49 and Q50 load onto one factor (Factor 6 in the Pattern Matrix) whereas items Q60 and Q61 load onto another factor (Factor 2 in the Pattern Matrix), a reading of the items suggest they could all be part of an "Experimentation" factor (Q49: "Supervisors encourage team members to experiment …"; Q50: "Innovative ideas are often rewarded by superiors"; Q60: "I often bring new ideas …"; Q61: "People … are encourage to question the way things are done"). These four items will probably need to be treated as an "Experimentation" factor (Q49, Q50, Q60 & Q61).

3. Again, although the Pattern Matrix suggests that item Q52 and Q53 load onto one factor (Factor 5 in the Pattern Matrix) whereas items Q54 and Q55 load onto another factor (Factor 3 in the Pattern Matrix), a reading of the items suggest they could all be part of a "Transfer of Knowledge" factor (Q52: "I often have an opportunity to talk to others about why tasks either succeed or fail"; Q53: "Failures are discussed constructively"; Q54: "New work processors … are shared with all appropriate workers"; Q55: "We have systems that allows us to learn successful practices from other organisations"). These four items will probably need to be treated as a "Knowledge Transfer" factor (Q52, Q53, Q54 & Q55).

4. Again, although the Pattern Matrix suggests that item Q56 and Q57 load onto one factor (Factor 4 in the Pattern Matrix) whereas items Q58 loads onto another, a reading of the items suggest they could all be part of a "Team Problem-Solving" factor (Q56: "We often approach our supervisors for guidance with a problem"; Q57: "We can usually form informal groups to solve problems"; Q58: "Most problem-solving features people from a variety of groups"). These three items will probably need to be treated as a "Team Problem-Solving" factor (Q56, Q57 & Q58).

DEFENCE SCIENCE AND TECHNOLOGY ORGANISATION
DOCUMENT CONTROL DATA

1. PRIVACY MARKING/CAVEAT (OF DOCUMENT)

2. TITLE

Development of the Army Learning Organisation Questionnaire: Identifying valid and reliable measures of a Learning Culture

3. SECURITY CLASSIFICATION (FOR UNCLASSIFIED REPORTS THAT ARE LIMITED RELEASE USE (L) NEXT TO DOCUMENT CLASSIFICATION)

Document	(U)
Title	(U)
Abstract	(U)

4. AUTHOR(S)

Christina Stothard

5. CORPORATE AUTHOR

DSTO Defence Science and Technology Organisation
506 Lorimer St
Fishermans Bend Victoria 3207 Australia

6a. DSTO NUMBER	6b. AR NUMBER	6c. TYPE OF REPORT	7. DOCUMENT DATE
DSTO-TN-1325	AR-016-028	Technical Report	July 2014

8. FILE NUMBER	9. TASK NUMBER	10. TASK SPONSOR	11. NO. OF PAGES	12. NO. OF REFERENCES
	ARM 08/0036	HMSP-A	36	57

13. DSTO Publications Repository

http://dspace.dsto.defence.gov.au/dspace/

14. RELEASE AUTHORITY

Chief, Land Division

15. SECONDARY RELEASE STATEMENT OF THIS DOCUMENT

Approved for public release

OVERSEAS ENQUIRIES OUTSIDE STATED LIMITATIONS SHOULD BE REFERRED THROUGH DOCUMENT EXCHANGE, PO BOX 1500, EDINBURGH, SA 5111

16. DELIBERATE ANNOUNCEMENT

No Limitations

17. CITATION IN OTHER DOCUMENTS Yes

18. DSTO RESEARCH LIBRARY THESAURUS

Organisational learning, assessment of organisational culture, measurement, psychometic development, reliability, validity

19. ABSTRACT

This report describes the development and psychometric evaluation of the Army Learning Organisation Questionnaire (ALOQ). Following a review of social sciences literature, four questionnaires used to measure learning organisation characteristics were identified, and then evaluated against specific validity and reliability criteria. Two instruments had the best psychometric properties; Marsick and Watkins' (2003) Dimensions of a Learning Organization (DLOQ) and Goh and Richard's (1997) Organisation Learning Survey (OLS). These two questionnaires were adapted for use within Army using a three phase pilot process. The resulting questionnaire was named the ALOQ. The ALOQ was administered to the target population (390 Army personnel) and its psychometric properties were evaluated. The ALOQ statistical reliability was found to be acceptable; Cronbach alphas over 0.7 for dimensions. ALOQ validity was evaluated using both theoretical and statistical means. An exploratory factor analysis found latent factors in line with those found in DLOQ and OLS (N=3700 Army personnel). Thus, the ALOQ was found to be reliable and valid measure of learning organization characteristics, suitable for administration within the military.